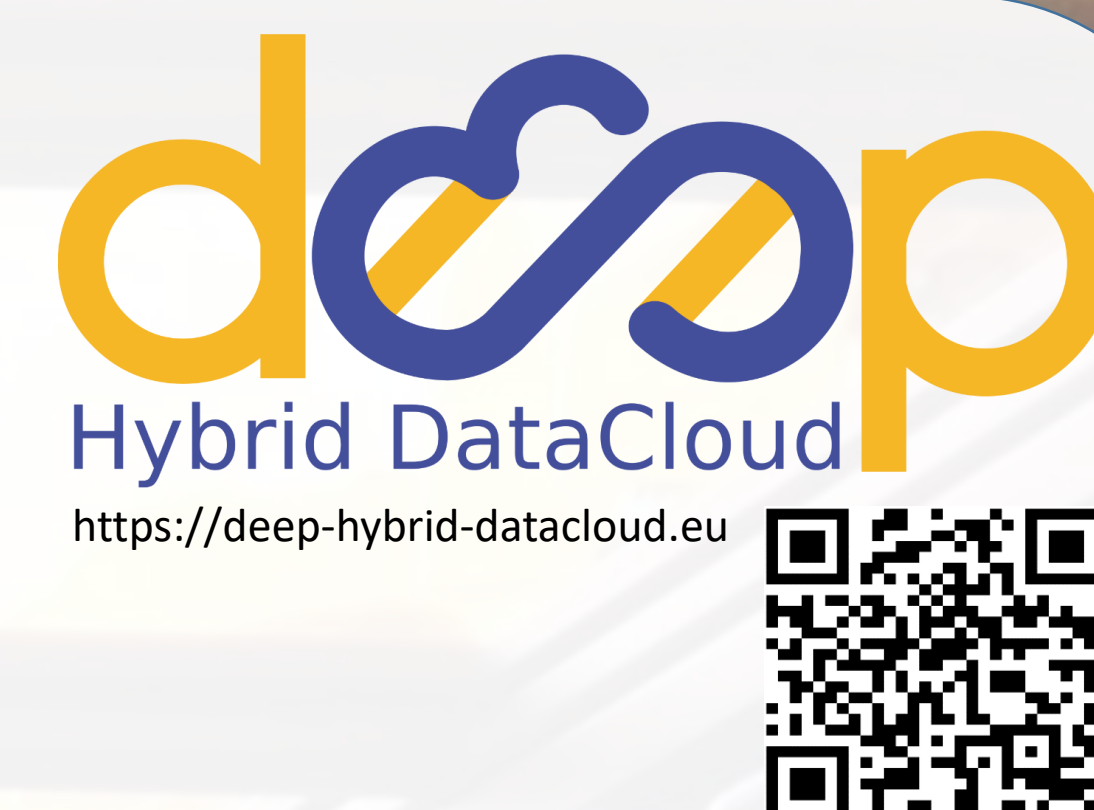


# DEEP: Hybrid approach for Deep Learning

A.S. Alic <sup>a)</sup>, M. Antonacci <sup>b)</sup>, M. Caballer <sup>a)</sup>, I. Campos <sup>c)</sup>, A. Costantini <sup>b)</sup>, M. David <sup>d)</sup>, S. Dlugolinsky <sup>e)</sup>, G. Donvito <sup>b)</sup>, C. Duma <sup>b)</sup>, J. Gomes <sup>d)</sup>, M. Hardt <sup>f)</sup>, I. Heredia <sup>c)</sup>, L. Hluchy <sup>e)</sup>, K. Ito <sup>g)</sup>, V. Kozlov <sup>f)</sup>, L. Lloret <sup>c)</sup>, A. López García <sup>c)</sup>, J. Marco <sup>c)</sup>, L. Matyska <sup>h)</sup>, G. Moltó <sup>a)</sup>, G. Nguyen <sup>e)</sup>, P. Orviz <sup>c)</sup>, M. Plociennik <sup>i)</sup>, Z. Šustr <sup>h)</sup>, V. Tran <sup>e)</sup>, P. Wolniewicz <sup>i)</sup>, W. zu Castell <sup>g)</sup>

a) UPV b) INFN c) CSIC d) LIP e) IISAS f) KIT g) HMGU h) CESNET i) PSNC



The DEEP-Hybrid-DataCloud project researches on intensive computing techniques such as needed for deep learning. This requires access to specialized GPU hardware to explore very large datasets. DEEP applies a hybrid-cloud approach that enables such access. We understand the needs of our user communities and help them to combine their services in a way that encapsulates technical details the end user does not have to deal with.

## DEEP Architecture components

### DEEPaaS API

DEEP as a Service API is a REST API focused on providing **Basic Users** with web access to machine learning models. **Advanced users** can integrate arbitrary machine learning models.

### DEEP Marketplace

The Open Catalog provides the universal point of entry to all services offered by DEEP:

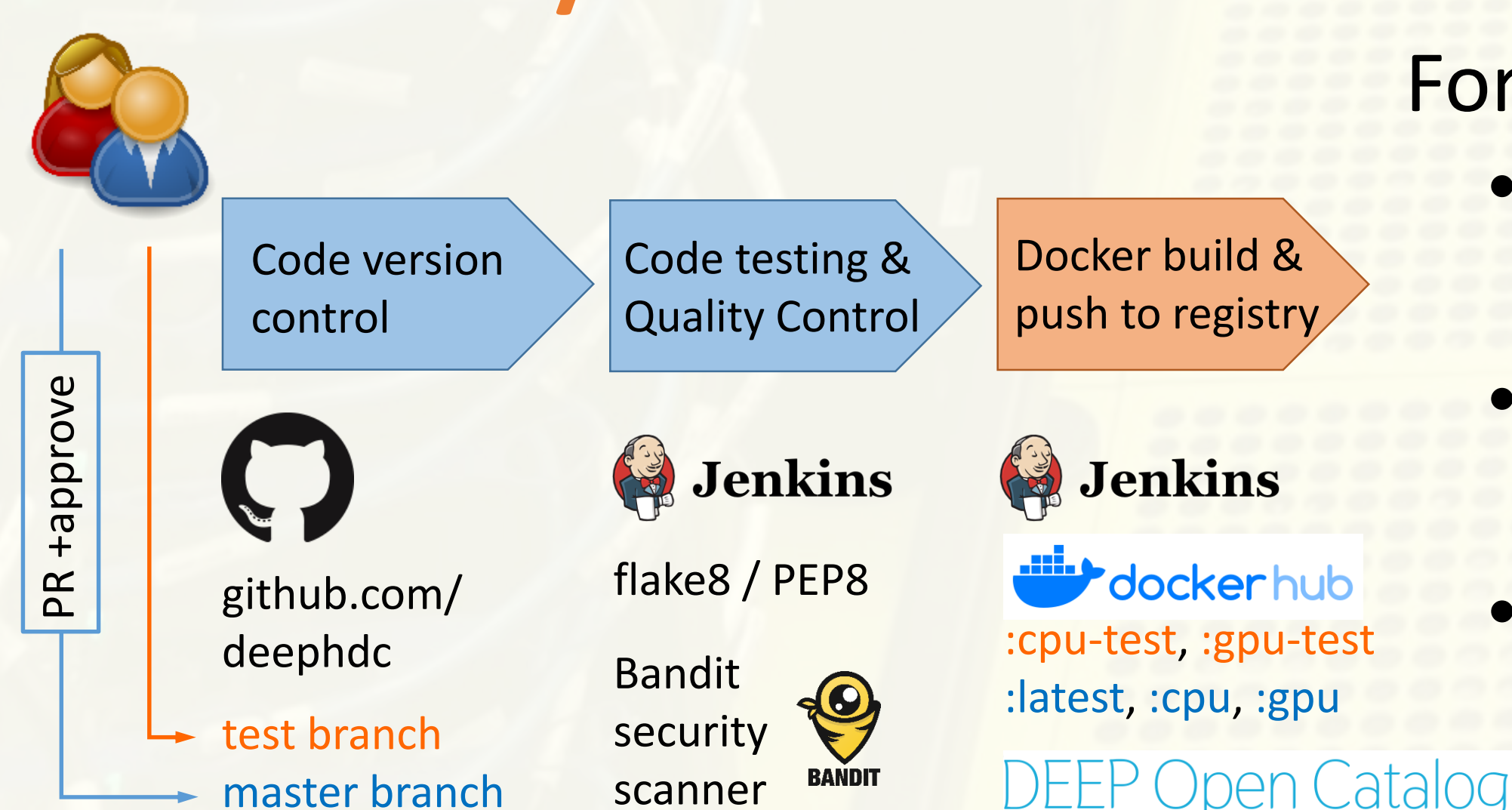
- Browse modules and learn from others
- Re-use and re-train existing modules
- Implement new

### Pilot Testbed

Heterogeneous sets of resources are provided:

- Access to resources through orchestrator
- Alien4Cloud for a graphical composition of complex infrastructures
- HPC resources
- Supporting Nextcloud for remote synchronization

### Jenkins CI/CD



For user applications:

- Automatization of code testing
- Docker image building
- Delivery to the registry

## Deep Learning Use-cases

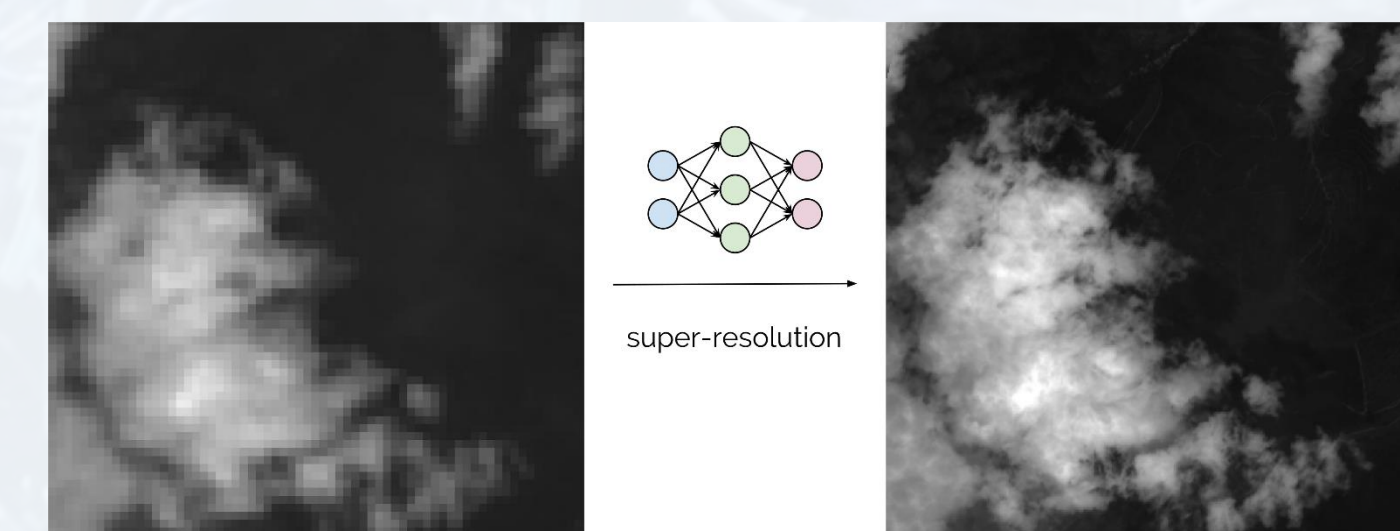
Exemplified use-cases demonstrating usefulness and scalability of the approach

### Image classification module

Generic model to train and test image classifiers (e.g. ResNet50, Xception). Several services are derived:

- Plants (Plantnet dataset)
- Seeds
- Conus marine snails
- Phytoplankton

### Satellite imagery

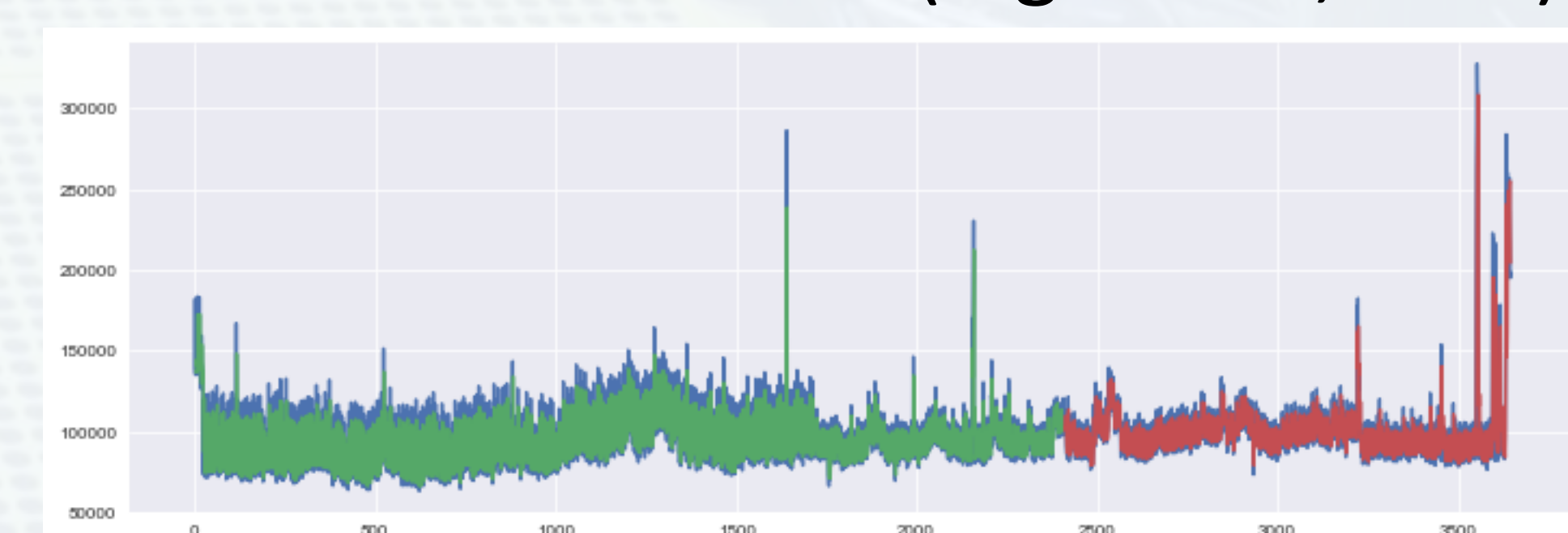


An image super-resolution service for satellite imagery (Sentinel2, Landsat8, VIIRS, MODIS) to upscale low resolution bands to high resolution with Deep Learning (e.g. DSen2)

### Massive Online Data Streams

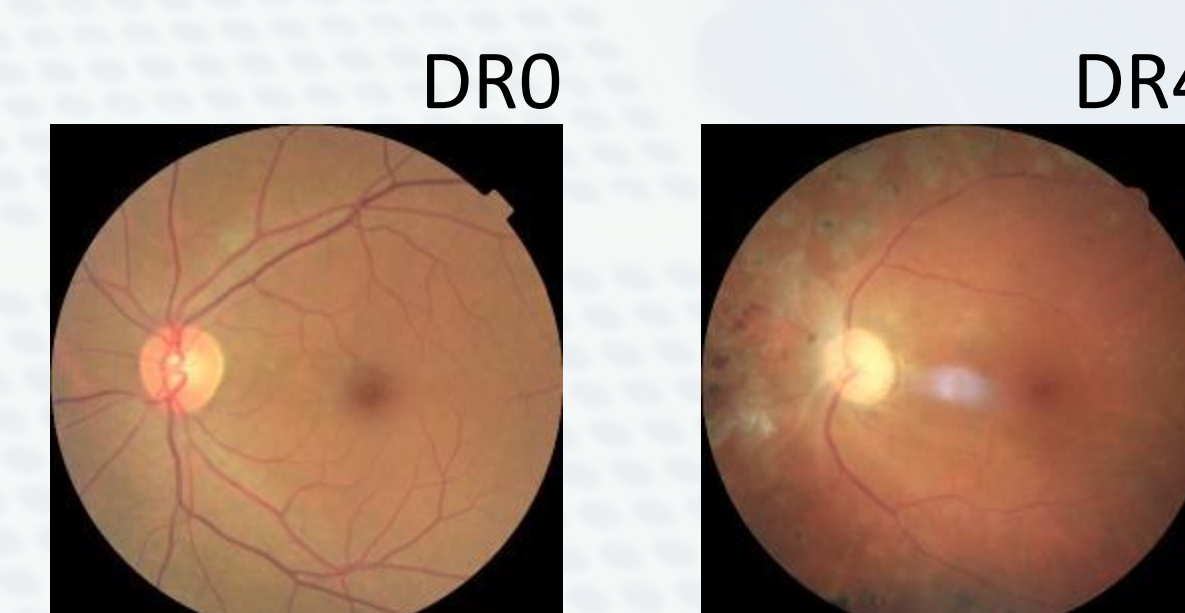
A service is aimed at analyzing online data streams in order to generate alerts in real-time. The principle is proactive time-series prediction adopting artificial neural networks (e.g. LSTM, GRU).

Fig.: dataset, prediction (train), prediction (test). 6 month monitoring dataset for network traffic



### Retinopathy

A deep learning approach (e.g. ResNet50, InceptionV3) for automated classification of retinopathy based on color fundus retinal photography images



Color fundus retinal photography images for a healthy (DR0) and the most pathological level (DR4)